



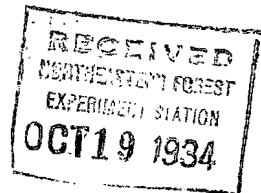
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FAILURE OF BLACK LOCUST - CONIFEROUS MIXTURES

IN THE CENTRAL STATES

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NORTHEASTERN FOREST EXPERIMENT STATION
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Forest planting is certain to occupy a leading place in the rehabilitation of waste lands in the Central States. The magnitude of the task of reforestation is indicated by the millions of acres of land involved, including marginal and submarginal areas, abandoned farms, denuded forest lands, washed and gullied fields and pastures, and idle acres too severely deteriorated to justify expenditures to restore them to productive use for crops or pasture. Many critical areas demand an immediate forest cover for erosion control and watershed protection.

Black locust is being used very extensively in present planting operations, especially those for erosion control. The extensive root system which develops with the establishment of the tree is capable of holding and stabilizing the soil surface, sprouts vigorously and prolifically, and contributes to increased soil fertility through the formation of root nodules with fixation of nitrogen.

It is generally recognized that mixed plantations of two or more species are better in many ways than pure stands of one species. Planted black locust has been found to be most thrifty (all factors considered) when growing in mixture with other species. The locust appears healthier; a better litter is formed which is more protective to the soil; and last but not least, the investigation of the locust borer by R. C. Hall has shown that the amount of attack and damage may be considerably reduced, even to the point of minor importance, by growing locust in mixed stands. Such mixtures more nearly approach natural stands in composition, with material safeguards against pathological and entomological attacks, which are the heritage of pure stands.

In considering the large planting problem in the Central States, many foresters including those of this Station, have advanced the suggestion of mixing conifers with black locust. Present planting operations frequently are following this suggestion. Some state forestry departments are recommending it to private cooperators and planters. The purpose behind the suggestion is entirely creditable. The object is to establish a thoroughly protective and productive tree cover; to bind the soil quickly (with the locust root system); to produce a more adequate leaf litter than that formed by locust alone; to reduce as far as possible the amount of damage by the locust borer; and to secure productive crops of timber, in addition to those of locust, or in case the locust succumbs to borer attack.

Before large amounts of time, labor, trees, and money are spent in following this plan, it is desirable to establish its likelihood of success. Several indicators are now at hand, thanks to the earlier plantings and experiments of several organizations. The Central States Forest Experiment Station has just finished a survey of plantations in the unglaciated portion of this region, during which all known plantings, young as well as old, were visited to appraise their condition, growth, and likelihood of success. In this survey, conducted by A. G. Chapman, the field party found a number of plantings of black locust-coniferous mixtures established under a variety of conditions. Consistent failure of the conifers was found to occur.

Without exception these mixtures have indicated real difficulties in securing favorable growth of conifers in mixture with black locust. The development of conifers in these plantings has been so poor and mortality has been so general that these mixtures, as made, are considered unsuccessful. It is the intent of this discussion to sound a warning against a continuation of past methods of planting locust-coniferous mixtures in one operation, and to urge experimentation in other methods of establishing mixtures, not overlooking the use and encouragement of volunteer hardwoods.

The species that have been observed, planted simultaneously with locust, or plantations in which root sprouts of locust have volunteered, include the following:

White pine	Ponderosa pine	Norway spruce
Jack pine	Scotch pine	Japanese larch
Red pine	Austrian pine	European larch
	Shortleaf pine	

These plantings were found in Ohio, Indiana, Illinois, and Kentucky. None were found in Missouri or Arkansas. Some of the older plantings are on strip coal lands, some on tight, poorly-drained soils of Illinoian glaciation, and some on residual clay banks. One is on loess. (Tennessee is now starting mixtures of locust with loblolly and shortleaf pines, but the plantations are still too recent to yield indications of success or failure.)

In no instances were conifers found to be vigorous beneath the locust. Before death occurs, it was observed that pine tips droop and turn brown. On strip coal lands, jack and Scotch pine were found dead beneath locust in one case; growth of red and Scotch pine was at a standstill in other mixtures with locust, although the pines alone were growing quite vigorously on adjacent spoil banks or fields. On another area sycamore and locust were overtopping red pines which were beginning to die. Death of Norway spruce planted beneath locust has been observed. The spruce-locust planting in Saginaw Forest at Ann Arbor, Michigan, is an exception and is the best appearing mixture with conifers found to date.

In a plantation established on loessial soil in 1928, red pine, white pine, Japanese larch, and European larch were mixed with the locust. All conifers failed. In 1929 the locust was underplanted again with conifers, substituting Austrian for white pine. In 1931 replanting was made with Scotch and Austrian pine. In 1934 a few pitch pine seedlings were used. All the conifers have been a failure, and the locust trees, although young, have closed their crowns and have produced stems of almost post size.

In one planting locust had made splendid growth while Scotch pine beneath was still of seedling size. Adjacent to this stand, ponderosa and Scotch pine, planted simultaneously, had reached heights of 15 feet. Yet the volunteer locust root sprouts were producing an advancing thicket which already was overtopping the adjacent pines. Height growth of the sprouts was 3 to 7 feet in one year's time.

Some of the causes of the coniferous failures are evident. The use of exotic, northern, and western species poorly adapted to the climatic conditions of this region is doubtless one cause.

Lack of light apparently is another. It is to be expected that the locust will establish more quickly and easily than the pine. The success of such mixtures hinges on the ability of the conifer, once it becomes established, to push up beneath or through the locust crown cover. This was not found to take place. Apparently light of a suitable intensity and quality for conifers to survive and grow does not filter through a closed locust canopy. Therefore, planting the two species simultaneously in one operation may be expected to fail.

Lack of moisture has been suggested as a cause. The recent years of drouth apparently were not a critical factor, since pines generally can survive a lower wilting point than hardwoods. In one case the soil was found to be visibly moist around drooping and browning red pines beneath locust, and quite dry around adjacent erect, thrifty young pines out in the open.

Excessive nitrogen from decomposition of nodules on locust roots is not a factor contributing to the failure of conifers. Nitrogen from this source becomes available continuously, and dissipates rather readily. It does not accumulate in great quantities, nor is it concentrated as in animal or bird residues. On the other hand, the death of large, thrifty white pines growing adjacent to locusts has been observed, indicating that there may be a locust toxin or some other factor inimical to conifers.

The success of releasing the suppressed pines by cutting the locust seems improbable, because of the vigorous sprouting capacity of locust. Furthermore such a step would be most unwise because vigorous root development of locust acts more effectively and quickly in tying down eroding soil than does that of any pine in the same period of time. Although no such instances were found, it is possible that a heavy infestation of locust borer might hold the locust trees in check sufficiently to allow the pine to dominate the stand. Volunteer eastern red cedar has been found in locust plantings, when these were rather open, on poor sites (for locust) and heavily infested with the locust borer.

The evidence of this plantation survey indicates that certain conifers cannot be planted simultaneously with black locust with the expectation of securing thrifty growth or even survival of the conifer. It is probable that where very heavy attacks of the borer retard the locust, the conifers may dominate the stand. It follows that underplanting older locust trees with conifers holds little promise of success in this region.

Obviously much additional experimentation is needed. It may be that native yellow pines will succeed where exotics have failed, -- particularly if the pines are given a good start before introducing the locust or if the locusts are widely spaced. R. C. Hall has found pitch pine and locust growing well together in the Pennsylvania foothills along the Juniata river. The pitch pine was 5 to 8 years older, however, and had the advantage of several years in height growth. It has been suggested that, for erosion control planting where an immediate cover is needed for critical areas, a plan of mixed planting in groups might meet with success. Under this suggestion the locust could be planted in and adjacent to the gullies, with pine on the areas between gullies. There is a possibility that the native yellow pines might be used successfully in mixtures of this type. Such a planting has not been found and it is highly advisable to test the idea experimentally before giving it general use or recommendation.

Foresters should not overlook the value of hardwoods in mixture with locust on favorable sites. An excellent locust planting with a volunteer understory of hard maple indicates that tolerant hardwoods may be good species to use in mixture. Yield plots in locust have recorded a considerable number of natural volunteer hardwoods which will grow beneath or in association with locust. Such natural succession indicates mixtures which foresters will be wise to follow and simulate. The acceptance and encouragement of most volunteer hardwood growth in planted locust groves cannot be urged too strongly.